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10/585,582	07/10/2006	Alexander Finkelstein	FINKELSTEIN1	8784

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EXAMINER	
REAMES, MATTHEW L	

ART UNIT	PAPER NUMBER
2893	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/585,582	FINKELSTEIN ET AL.	
	Examiner	**Art Unit**	
	Matthew Reames	2893	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 May 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-13,23,24,26-28,30-48 and 50-56* is/are pending in the application.

4a) Of the above claim(s) *56* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-13,23,24,26-28,30-48 and 50-55* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *11/20/2006,*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Group I, Species A in the reply filed on 5/18/2009 is acknowledged.

2. Claim 56 is withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species B since the device of claim 56 uses the mobility as opposed to the 2DEG structure, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 5/18/2009.

Claim Objections

3. Claim 38 is objected to because of the following informalities: lenses take many forms therefore it unclear what constitutes a lens geometry other than a curved geometry; the phrase "lens-like" is unclear. Appropriate correction is required.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claim 1, 3-11, 26-28, 30, 36, 50, and 51 are rejected under 35 U.S.C. 102(a) as being anticipated by Chen (Spin-polarized reflection).

a. As to claim 1 Chen teaches a device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of at least one parameter selected from a spin-orbit coupling constant, density of the spin carrying current carriers, and a mobility of the gas, the device having one of the following configuration (see e.g. figure 1 barriers and abstract and page 9): said structure is configured to provide the two-dimensional gas configuration with a desired orientation between an input flux of the spin carrying current carriers and said at least one region of inhomogeneity (see e.g. barriers and page 3 2DES region), which has the varying spin-orbit coupling constant and/or has the varying density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value (see e.g. abstract), the device being thereby operable to perform spin manipulations of the input flux to provide at least one of the following types of deviation of said spin carrying current carriers (see e.g. abstract and figure 1): spin dependent refraction, spin dependent reflection (see e.g. title) and spin dependent diffraction on desired deviation angles of a direction of motion of the spin carrying current carriers being incident on said at least one region of inhomogeneity; said desired orientation being such that the input flux of the spin carrying current carrier contains carriers that impinge onto said at least

one region of inhomogeneity at a certain range of non-zero angles of incidence (see e.g. figure 1). the device being thereby operable for emitting the current carriers from the diffusive region into the ballistic region with a wide angular range of directions of propagation of the current carriers in the ballistic region, thereby enabling directing the current carriers to one or more desired range of angles of propagation in the ballistic region (see e.g. figure 1).

b. As to claims 3-5, Chen teaches the structure is configured such that the inhomogeneous two-dimensional gas is confined by at least one potential well created by a hetrostructure (see e.g. pages 3-4).

c. As to claims 6-7, and 9 Chen teaches a asymmetrical potential well/non-uniform to confine the 2DEG/2DES (see e.g. pages 3-4).

d. As to claim 8, Chen teaches a structure a uniaxial crystal compound with no inversion symmetry (see e.g. pages 3-4).

e. As to claim 10, Chen teaches a heterostructure (see .g. pages 3-4).

f. As to claim 11 Chen teach III-V semiconductor device (see e.g. page 9).

g. As to claim 26, Chen teaches electrons (see e.g. title).

h. As to claim 27, Chen teaches comprising at least one injector terminal and at least one collector terminal distant from each other (see e.g. figure 1), each terminal being defined by a space between two nearest barriers arranged in said structure (see e.g. figure 1), the terminals being arranged for allowing the carriers passage from the injector terminal to the collector terminal (see e.g. figure 1).

i. As to claim 28, Chen comprising at least one injector terminal and at least one collector terminal distant from each other (see e.g. figure 1), each terminal being defined by a space between two nearest barriers arranged in said structure (see e.g. figure 1), the terminals being arranged for allowing the carriers passage from the injector terminal to the collector terminal (see e.g. figure 1).

j. As to claim 30, Chen teaches wherein said at least one injector terminal is configured for providing the input flux of unpolarized spin carrying current carriers (see e.g. figure 1 and description), and said at least one collector terminal is configured for receiving a current of spin-polarized spin carrying current carriers(see e.g. figure 1 and description), the device being therefore configured and operable as a spin filter for producing a current of spin carriers having the predetermined spin polarization(see e.g. figure 1 and description).

k. As to claim 36, Chen wherein said structure is configured to create the region of inhomogeneity in the form of a lateral interface between two regions of the gas having different values of the spin-orbit coupling constant (a heterostructure device see e.g. page 3-4).

l. As to claim 50, Chen teaches a device for manipulating the direction of motion of current carriers (see e.g. abstract and figure 1), the device comprising a structure containing a two-dimensional gas (see e.g. page 3) of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers

provided the spin-orbit coupling constant is of non-zero value (see e.g. figure 1), the structure being configured to provide a desired orientation between an input flux of unpolarized spin-carrying current carriers and said at least one region of inhomogeneity, the device being thereby configured and operable as a spin filter for producing a current of spin carriers having a predetermined spin polarization (see e.g. figure 1).

m. As to claim 51, Chen teaches a device for manipulating a direction of motion of current carriers (see e.g. abstract and figure 1), the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value (see e.g. abstract page 3 and figure 1), the structure being configured to provide a desired orientation between an input flux of unpolarized spin-carrying current carriers and said at least one region of inhomogeneity (see e.g. figure 1). Since the device has the same structure it must inherently be capable of being therefore configured and operable as a spin polarization splitter it is also must be configurable as a spin focusing device. Applicant does dot recite any additional structure to distinguish a spin splitter from a focusing device. Applicant recites a existing structure and the structure because of it having the structure therefore performs the action.

6. Claim 54 is rejected under 35 U.S.C. 102(b) as being anticipated by Kiselev (T-shape spin filter with resonator.

a. As to claim 54, Kiselev teaches a device A device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value (see e.g. figure 1(b) and associated section on pages 4003-4004), the structure being configured to provide a desired orientation between an input flux of spin-carrying current carriers and said at least one region of inhomogeneity, said at least one region of inhomogeneity of the gas being configured in the shape of a closed loop (see e.g. figure 1(b)and page 4001), thus because of the split gate the device can be configured to close the loop since the gate controls the structure of the gas. Kiselev teaches having an entrance (see e.g. entrance portion figure 1(b) and at least one exit for guiding the spin polarized spin carrying current carriers along said region of inhomogeneity owing to the total internal reflection of the spin carrying current carriers (see e.g. the straight portion leading to the resonator, thus the device can act as a spin storage of the spin carrying current carriers.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claim 12, 13, 23, 24, 40-42, 48 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Kiselev (T-shaped spin filter with resonator cited on IDs).

a. As to claims 12 and 13, Chen does not teach InGaAs/InAlAs with y=1 and x=.1 to 1.

Kiselev teaches InAs/InGaAs has the same affect as InSb/InAlSb (see entirety of Kiselev).

Thus it would have been obvious to one of ordinary skill in the art at the time of the invention to use a heterostructure wit InAs/In0.1Ga0.9As

One would have been so motivated in order to integrate with other GaAs devices and for the optimization of the spin coupling in the material.

b. As to claim 23, Chen does not teach at least one gate configure for applying a bias voltage thereto, said bias voltage being sufficient to change said at least one parameter in a region of the two dimensional gas near said at least one gate to thereby create the region of inhomgeneity.

Kiselev teaches a split gate structure to induce the 2DES/2DEG (see e.g. Structure and Hamiltonian section).

Therefore it would have been obvious to one of ordinary skill in art at the time of the invention to form at least one gate configure for applying a bias voltage thereto, said bias voltage being sufficient to change said at least one parameter in a region of the two dimensional gas near said at least one gate to thereby create the region of inhomgeneity.

One would have been so motivated to allow optimization of the 2DES/2DEG system optimizing spin orbit coupling.

c. As to claim 24, Chen/Kiselev of claim 23 does not explicitly teach wherein the varying of the spin orbit coupling constant of the gas within the region of the inhomogeneity of the gas is measure in units of Fermi velocity is larger than about 0.001.

However, the modified device of claim 23 would be capable of having such a variation since the spin orbit coupling is control by the gates. Since the device is capable of performing such an action the device of Chen/Kislev reads on the claim.

d. As to claim 40, Chen does not teach wherein said structure is configured to create the region of inhomogeneity in the form of an elongated stripe which has the relatively reduced or relatively enhanced spin-orbit coupling constant and/or the density of the spin-carrying current carriers as compared to the gas surroundings of said stripe.

Kiselev teaches a structure is configured to create the region of inhomogeneity in the form of an elongated stripe which has the relatively reduced

or relatively enhanced spin-orbit coupling constant and/or the density of the spin-carrying current carriers as compared to the gas surroundings of said stripe (see e.g. figure 1). This structure is used as an input for the filter region.

Therefore it would it would have been obvious to provide in Chen a region wherein said structure is configured to create the region of inhomogeneity in the form of an elongated stripe which has the relatively reduced or relatively enhanced spin-orbit coupling constant and/or the density of the spin-carrying current carriers as compared to the gas surroundings of said stripe.

One would have been so motivated to provide an input means to the spin filter.

e. As to claim 41-42, the device of Chen/Kiselev has the same strip portion as claimed thus is inherently capable of performing a step wherein at least one spin polarization component of the input flux of the spin-carrying current carriers undergoes total internal reflection while passing along/trough the stripe.

f. As to claim 48, the device of claim 42 of Chen/Kiselev teaches a device comprising a gate configured for altering a bias voltage being sufficient to affect said inhomogeneous two-dimensional gas of spin carrying current carriers.

The device would therefore be capable of providing a bias voltage being applied to the gate for switching the deviation angles of at least a portion of the spin carrying current carriers between different predetermined ranges of angles; thereby to provide a spin switch device, thus the device meets the limitation of the claim.

g. As to claim 53, Chen teaches a device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value (see e.g. figure 1 and page 3), the structure being configured to provide a desired orientation between an input flux of spin-carrying current carriers and said at least one region of inhomogeneity (see e.g. figure 1).

Kiselev teaches wherein said at least one region of inhomogeneity of the gas being configured for guiding the spin polarized spin carrying current carriers along said region of inhomogeneity of the gas (see e.g. figure 1 the straight section leading into the spin filter). The total internal reflection of the spin carrying current carriers to convey the spin current to a predetermined location in the device depend on the initial angle of the beam thus the straight portion of Kiselev is capable of internal reflection. Further the straight portion of the device acts as a spin guide.

Therefore it would it would have been obvious to provide in Chen a region wherein said structure is configured to create the region of inhomogeneity in the form of an elongated stripe which has the relatively reduced or relatively enhanced spin-orbit coupling constant and/or the density of the spin-carrying current carriers as compared to the gas surroundings of said stripe.

One would have been so motivated to provide an input means to the spin filter.

h. As to claim 55, Chen teaches A device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value (see e.g. abstract figure 1, page 3), the structure being configured to provide a desired orientation between an input flux of spin-carrying current carriers and said at least one region of inhomogeneity (see e.g. figure 1),

Chen does not teach a device comprising a gate configured for altering a bias voltage being sufficient to affect said inhomogeneous two-dimensional gas of spin carrying current carriers, said bias voltage being applied to the gate for switching deviation angles of at least a portion of the spin carrying current carriers between different predetermined ranges of angles; thereby to provide a spin switch device.

Kiselev teaches a split gate structure to induce the 2DES/2DEG and to form the structure of the 2DEG/ (see e.g. Structure and Hamiltonian section).

Therefore it would have been obvious to one of ordinary skill in art at the time of the invention to form at least one gate configure for applying a bias voltage thereto, said bias voltage being sufficient to change said at least one

parameter in a region of the two dimensional gas near said at least one gate to thereby create the region of inhomgeneity. Thus due to the nature of the split gate a bias voltage being applied to the gate would switch deviation angles of at least a portion of the spin carrying current carriers between different predetermined ranges of angles; thereby to provide a spin switch device.

One would have been so motivated to allow optimization of the 2DES/2DEG system optimizing spin orbit coupling.

9. Claims 43 and 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen/Kiselev as applied to claim 42 above, and further in view of Kaneyama (20010010358).

a. As to claim 43, Kiselev teach forming a curved stripe portion (see e.g. figure 1 resonator) but does not provide a motivation why one would incorporate such a structure in a device for other than filtering.

Kaneyama teach that it was known to redirect electron beam for different reasons (see e.g. figure 3 item O).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention at the time of the invention to have used the curved stripe portions in the device of Kiselev in combination with the device of Chen.

One would have been so motivated to allow for beam steering.

b. As to claim 46, the device of Chen/Kiselev/Kaneyama of claim 43 would inherently provide a device wherein said at least one region of inhomogeneity of

the gas is configured for guiding the spin polarized spin carrying current carriers along said region of inhomogeneity of the gas owing to the total internal reflection of the spin carrying current carriers to convey the spin current to a predetermined location in the device, to thereby provide a spin guide.

10. Claim 47 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen/Kiselev/Kaneyama as applied to claim 43 above, and further in view of Miyata (5,001,437).

a. As to claim 47 the device of Chen/Kiselev/Kaneyama provides for a curved portion/a ring resonator but does not teach a storage ring.structure.

Miyata teaches storage ring for electron were known (see e.g. vlsim 28).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to have configure a ring region in the device of Chen/Kiselev/Kaneyama for storage of the electron to ensure the spin does not change or the electron does not interact with other portions of the device.

11. Claim 31 rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Katoh (6,333,516).

a. As to claim 31, Chen does not teach wherein said at least one injector terminal is configured for providing the input flux of unpolarized spin carrying current carriers, and the at least two collector terminals are configured, each for

receiving currents of the spin polarized spin carrying current carriers, the device being therefore configured and operable as a spin polarization splitter.

Katoh teaches a two collector terminal was know for spin splitting (see e.g. figure 20).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to have configured for providing the input flux of unpolarized spin carrying current carriers, and the at least two collector terminals are configured, each for receiving currents of the spin polarized spin carrying current carriers, the device being therefore configured and operable as a spin polarization splitter.

One would have been so motivated to utilized all the electron going through the filter.

b. As to claim 32, Chen/Katoh does not teach comprising a charge sensor arranged at said at least one collector terminal and configured for receiving a flux of the spin carrying current carriers having the predetermined spin polarization; the device being thereby configured and operable as a spin detector for detecting a spin polarization of the spin carriers.

However, charge detectors were known.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to have added a charge sensor at the collector.

One would have been so motivated to ensure only electron were passing into the collector and no positron passed through.

The device would inherently be able to function as a spin detector.

12. Claim 37 rejected under 35 U.S.C. 103(a) as being unpatentable over Chen.

a. As to claim 37, Chen teaches sharp corners. Chen does not teach a "curved geometry."

However, it was known it was very difficult to make sharp corners using current process techniques.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to have formed the geometry curved as opposed to sharp corners.

One would have been so motivated since it would provide the same effect but allow more natural interfaces to be used and easier fabrication.

13. Claim 38-39 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Kiselev (T-shaped spin filter with resonator cited on IDS), and in view of Kaneyama (20010010358).

a. As to claims 38-39, Chen does not teach wherein said structure is configured to define the region of inhomogeneity of the gas having a lens-like geometry with a relatively reduced or relatively enhanced spin-orbit coupling constant and/or the density of the spin-carrying current carriers as compared to the gas surroundings of said lens-like region.

Kiselev teach manipulating the motion of an electro by using the interaction of the spin of the electron and the orbit of a 2DEG (see e.g. abstract).

Kaneyama teaches that magnetic lens for electrons were known (using the spin of the electron to form a lens).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to have used the motion manipulation methods of Cjen and Kiselev to form an electron lens.

One would have been so motivated to allow manipulation of current without the use of a magnetic. A magnetic can adversely affect other devices or material in the area. This would entail the use of diffraction to focus the beam of electrons.

b. As to claim 45, the device of Chen/Kiselev/Kaneyama as per claims 38-39 would provide a device wherein said at least one region of inhomogeneity of the gas is configured for redirecting the spin carrying current carriers, thereby to provide a spin focusing of the spin carrying current carriers (a electron beam lens).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew Reames whose telephone number is (571) 272-2408. The examiner can normally be reached on M-Th 6:00 am-4:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Davienne Monbleau can be reached on (571)272-1945. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MLR/

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